Mass Extinctions

Name: _____

Date: _____ Score: _____

Problem: When did mass extinctions occur on Earth and what are some possible causes?

Background:

Imagine a world where up to 90% of all existing species become endangered relatively suddenly, all at the same time. What could cause such a situation and could it actually occur? In fact, mass extinctions have occurred several times during the history of life on the Earth. Fossil and geologic evidence indicates that mass extinctions occurred world-wide five different times, 440 million years ago, 365 million years ago, 250 million years ago, 215 million year ago, and most recently, 68 million years ago. Could it happen again? If it did, which phyla of living organisms are likely to survive and why? In this activity, you will learn about such occurrences in the past and consider what circumstances or conditions could cause such a devastating catastrophe worldwide.

Procedure:

A. Study the "Geologic Time Scale" and "North American Rock Record" included in this activity. Note any trends or patterns that seem to occur in the major events of the various geologic time periods. Also refer to the Mass Extinctions Theories section and compare the data from the tables to the theories to see if any match.

B. Review the approximate dates of the mass extinctions known to have occurred given in the scale and record. Develop a hypothesis as to what may have caused each of the mass extinctions. Note whether each may have had unique contributing circumstances or whether there may have been common factors contributing to several or all of these events. Your hypothesis should be based on the information from the tables and logical inferences.

Hypothesis:

C. What other information does your group need to have a better understanding of what could have caused the mass extinctions? (Refer to your notes where necessary)

D. Come up with a final hypothesis for each mass extinction. Be sure to support your hypothesis with information, data, or observations about the conditions and circumstances which existed on Earth at the particular times.

440 m.y.a.:

365 m.y.a.:

250 m.y.a.:

215 m.y.a.:

68 m.y.a.:

Analysis and Conclusions:

1. What difficulties did you have in trying to solve the mystery of the 5 mass extinctions?

2. What are some possible sources of further information that could help you get closer to determining the exact causes of each of the mass extinctions?

3. Do you think another mass extinction could occur on the Earth? Explain your reasoning.

4. Describe the likely cause of a mass extinction yet to occur. What type of organisms would you propose have the greatest chance of survival? Explain what it is about them that makes their survival more likely than other species.

5. In any of the possible causes of mass extinctions were to occur again in modern times, what if anything, could humans do to prevent a world-wide mass extinction?

Geologic Time Scale

Era	Period	Epoch	Millions of years from start to present	Major Events
Cenozoic	Quarternary	Recent (Holocene)	0.01	Repeated glaciations; extinctions of large mammals; evolution of Homo sapiens; rise of civilizations.
		Pleistocene	2.0	
	Tertiary	Pliocene	5.1	Radiation of mammals, birds, angiosperms, pollinating insects. Continents nearing modern positions. Drying trend in mid-Tertiary.
		Miocene	24.6	
		Oligocene	38.0	
		Eocene	54.9	
		Paleocene	65.0	
Mesozoic	Cretaceous		144	Most continents widely separated. Continued radiation of dinosaurs. Angiosperms and mammals begin diversification. Mass extinction at end of period.
	Jurassic		213	Diverse dinosaurs; first birds; archaic mammals; gymnosperms dominant; ammonite radiation. Continents drifting.
	Triassic		248	Early dinosaurs; first mammals; gymnosperms become dominant; diversification of marine invertebrates. Continents begin to drift. Mass extinction near end of period.
Paleozoic	Permian		286	Reptiles, including mammal-like forms, radiate amphibians decline; diverse orders of insects. Continents aggregated into Pangaea; glaciations. Major mass extinction, especially of marine forms, at end of period.
	Carboniferous (Pennsylvanian and Mississippian)		360	Extensive forests of early vascular plants, especially lycopsids, sphenopsids, ferns. Amphibians diverse; first reptiles. Radiation of early insect orders.
	Devonian		408	Origin and diversification of bony and cartilaginous fishes; trilobites diverse; origin of ammonoids, amphibians, insects. Mass extinction in late period.
	Silurian		438	Diversification of agnathans, origin of placoderms; invasion of land by tracheophytes, arthropods.
	Ordovician		505	Diversification of echinoderms, other invertebrate phyla, agnathan vertebrates. Mass extinction at end of period.
	Cambrian		570	Appearance of most animal phyla; diverse algae.
Pre-Cambrian	Vendian		670	Origin of life in remote past; origin of prokaryotes.
	Surtian		800	Origin of later eukaryotes; several animal phyla near end of era.

North American Rock Record

Time Period millions of years	Geologic Events
0–2	West coast uplift continues in U. S. Great Lakes form.
1–2	Ice Age. Raising of mountains and plateaus in Western U. S.
2–5	N. America joined to S. America. Sierras and Appalachians re-elevated by isostatic rebound.
5–23	N. America joined to Asia. Volcanism in Northwest U. S., Columbia Plateau.
23–37	Alps and Himalayas forming. Volcanism in Western U. S.
37–53	Coal forming in the Western U. S.
53–65	Uplift in Western U. S. continues.
65–135	Uplift of Rockies begins. Colorado Plateau raised. Coal swamps in Western U. S. Intrusion of Sierra Nevada batholith.
135–205	West-central N. America under huge sea. Gulf of Mexico Atlantic Ocean begin to form.
205–250	Volcanism and faulting along East coast. Palisades of Hudson formed.
250–290	Final uplift in Appalachians. Ice Age in S. America. Salt-forming deserts in Western U. S.
290–320	Great coal forming swamps in N. America and Europe.
320–355	Extensive submergence of continents.
355–410	Mountain building continues in New England and Canada. White Mountains raised.
410–440	Salt-and-gypsum-forming deserts in Eastern U. S.
440–510	Beginning of Appalchian mounting building. Taconic and Green Mts. form. Half of N. America is submerged.
510–570	Extensive deposition of sediments in inland seas.
570–?	Great volcanic activity, lava flows, metamorphism of rocks.

Mass extinction theories
Asteroid impacts, climate change, volcanoes - there have been many theories about the causes of mass extinctions. In some cases, such as the Cretaceous mass extinction event, more than one such factor was involved in the global catastrophe.

Catastrophic methane release
Catastrophic methane release has been suggested as a possible cause of mass extinction. Methane clathrate is an ice-like substance formed from water and methane in the sea bed, arctic lakes and permafrost.

Flood basalt eruptions
Flood basalt eruptions are a type of large-scale volcanic activity, both in terms of extent and duration, that can occur on land or on the ocean floor. A flood basalt may continue to erupt for tens of thousands - possibly millions - of years and the lava can cover hundreds of thousands of kilometres.

Climate change
Earth's climate is not constant. Over geological time, the Earth's dominant climate has gone from ice age to tropical heat and from steamy jungles to searing deserts.

Impact events
Impact events, proposed as causes of mass extinction, are when the planet is struck by a comet or meteor large enough to create a huge shockwave felt around the globe. Widespread dust and debris rain down, disrupting the climate and causing extinction on a global, rather than local, scale.